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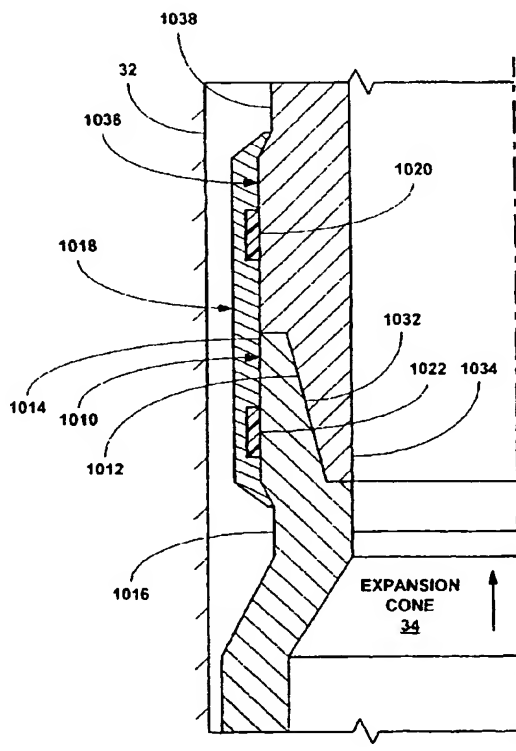
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[Continued on next page]

(54) Title: PROTECTIVE SLEEVE FOR THREADED CONNECTIONS FOR EXPANDABLE LINER HANGER



(57) Abstract: A tubular sleeve (1018) is coupled to and overlaps the threaded connection (1012, 1032) between a pair of adjacent tubular members (1016, 1038).

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US03/06544

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : E21B 19/16

US CL : 166/380, 85.3, 309, 387, 72, 73; 285/382.7, 398

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 166/380, 85.3, 309, 387, 72, 73, 187, 195, 206, 207, 212, 216, 217; 285/382.7, 398, 55, 388.1

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
None

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EAST

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6,405,761 B1 (SHIMIZU et al) 18 June 2002, see entire document	1-120
A	US 5,971,443 A (NOEL et al) 26 October 1999, see entire document	1-120
A	US 5,309,621 A (O'DONNELL et al) 10 May 1994, see entire document	1-120
A	US 3,997,193 A (TSUDA et al) 14 December 1976, see entire document	1-120
A	US 3,989,280 A (SCHWARZ) 02 November 1976, see entire document	1-120
A	US 3,834,742 A (MCPHILLIPS) 10 September 1974, see entire document	1-120
A	US 3,579,805 A (KAST) 25 May 1971, see entire document	1-120
A	US 2,647,847 A (BLACK et al) 04 August 1953, see entire document	1-120
X	US 4,693,498 A (BLAUGH et al) 15 september 1987, see Fig. 2a and 2b.	54

☒ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"Z" document member of the same patent family

Date of the actual completion of the international search

30 July 2003 (30.07.2003)

Date of mailing of the international search report

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C. (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6,275,556 B1 (KINNEY et al) 14 August 2001. see Fig. 3	54

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US03/06544

Box I Observations where certain claims were found unsearchable (Continuation of Item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claim Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claim Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claim Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of Item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:
Please See Continuation Sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐
☐

The additional search fees were accompanied by the applicant's protest.

No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

PCT/US03/06544

BOX II. OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING

The inventions listed as Groups I-IV do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

The independent claims of the Group I inventions all require the radial-plastic deformation of a jointed tubular connection whereas the independent claims of Group II inventions make no such requirement. Group III claims differ in that the independent claims require the radial-plastic deformation of the tubular connections in a method and/or apparatus used in extracting geothermal energy from a geothermal well whereas the Group IV invention makes no such deformation requirement. The Group I and II claims further differ in requiring tubular connections involving internal or external tubular threads with corresponding internal or external threaded sleeve ends. The independent claims of Groups III and IV all require their use as a liner in the completion of a well to be used in extracting geothermal energy.

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I, claim(s) 1-53, drawn to a "Method."

Group II, claim(s) 54-110, drawn to an "Apparatus."

Group III, claim(s) 111-119, drawn to a "Method and Apparatus for Extracting Geothermal Energy."

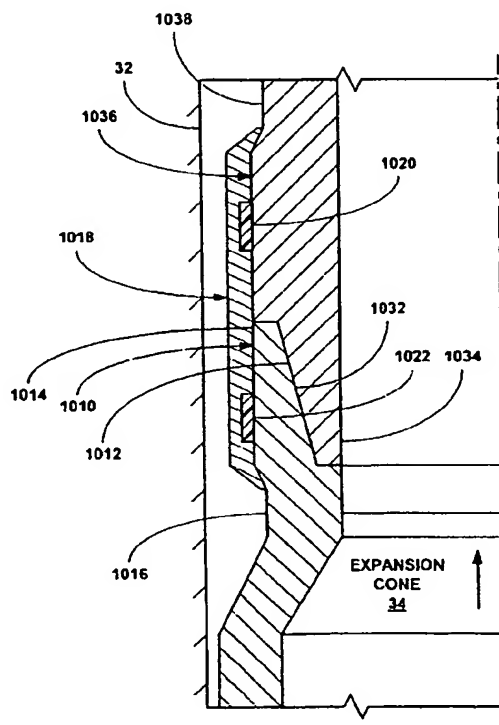
Group IV, claim(s) 120, drawn to an "Apparatus for Extracting Geothermal Energy."

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000 1001 1002 1003 1004 1005 1006 1007 1008 1009 1010 1011 1012 1013 1014 1015 1016 1017 1018 1019 1020 1021 1022 1023 1024 1025 1026 1027 1028 1029 1030 1031 1032 1033 1034 1035 1036 1037 1038 1039 1040 1

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[Continued on next page]

(57) Abstract: A tubular sleeve (1018) is coupled to and overlaps the threaded connection (1012, 1032) between a pair of adjacent tubular members (1016, 1038).



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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

AMENDED CLAIMS

[received by the International Bureau on 06 August 2004 (06.08.04);
new claims 121-153 added; remaining claims unchanged (7 pages)]

- a first tubular member received within an end of the tubular sleeve in abutment with the internal flange that comprises internal threads; and
- a second tubular member received within another end of the tubular sleeve in abutment with the internal flange that comprises external threads that engage the internal threads of the first tubular member.
120. An apparatus for extracting geothermal energy from a subterranean source of geothermal energy, comprising:
- a borehole that traverses the subterranean source of geothermal energy;
 - a first casing string positioned within the borehole; and
 - a second casing string positioned within the borehole that traverses the subterranean source of geothermal energy that overlaps with the first casing string;
- wherein the interior diameter of a passage defined by the first and second casing strings is constant; and
- wherein at least one of the first and second casing strings comprise:
- a tubular sleeve comprising an external flange positioned between the ends of the tubular sleeve;
 - a first tubular member that receives an end of the tubular sleeve that abuts external flange that comprises internal threads; and
 - a second tubular member that receives another end of the tubular sleeve that abuts the external flange that comprises external threads that engage the internal threads of the first tubular member.
121. A method of radially expanding and plastically deforming a first tubular member and a second tubular member, comprising:
- coupling an end of the first tubular member with an end of a tubular sleeve;
 - coupling an end of the second tubular member with another end of the tubular sleeve;
 - placing the tubular members within a wellbore; and
 - displacing an expansion device through the interiors of the first and second tubular members to radially expand and plastically deform portions of the first and second tubular members.
122. The method of claim 121, wherein the ends of the first and second tubular members are received within the ends of the tubular sleeve.
123. The method of claim 121, wherein the ends of the first and second tubular members receive the ends of the tubular sleeve.
124. The method of claim 121, wherein, before, during, and after the radial expansion of the portions of the first and second tubular members, a fluid tight seal is provided by the interface between the tubular sleeve and the ends of the first and second tubular members.
125. A method of radially expanding and plastically deforming a first tubular member and a second tubular member, comprising:
- coupling an end of the first tubular member with an end of a tubular sleeve;

coupling an end of the second tubular member with another end of the tubular sleeve; and displacing an expansion device through the interiors of the first and second tubular members to radially expand and plastically deform portions of the first and second tubular members; wherein, before, during, and after the radial expansion of the portions of the first and second tubular members, a fluid tight seal is provided by the interface between the tubular sleeve and the ends of the first and second tubular members.

126. The method of claim 125, wherein the ends of the first and second tubular members are received within the ends of the tubular sleeve.

127. The method of claim 125, wherein the ends of the first and second tubular members receive the ends of the tubular sleeve.

128. The method of claim 125, further comprising:

placing the tubular members within a wellbore; and

then displacing an expansion device through the interiors of the first and second tubular members to radially expand and plastically deform portions of the first and second tubular members.

129. An apparatus, comprising:

a tubular sleeve;

a first tubular member coupled to an end of the tubular sleeve comprising internal threads at an end portion; and

a second tubular member coupled to another end of the tubular sleeve comprising external threads at an end portion that engage the internal threads of the end portion of the first tubular member;

wherein the tubular sleeve is in circumferential tension;

wherein the end portion of the first tubular member is in circumferential compression; and

wherein the end portion of the second tubular member is in circumferential compression.

130. An apparatus, comprising:

a tubular sleeve;

a first tubular member coupled to an end of the tubular sleeve comprising internal threads at an end portion; and

a second tubular member coupled to another end of the tubular sleeve comprising external threads at an end portion that engage the internal threads of the end portion of the first tubular member;

wherein the tubular sleeve is in circumferential compression;

wherein the end portion of the first tubular member is in circumferential tension; and

wherein the end portion of the second tubular member is in circumferential tension.

131. An apparatus, comprising:

a tubular sleeve;

a first tubular member coupled to an end of the tubular sleeve comprising internal threads at an end portion; and

a second tubular member coupled to another end of the tubular sleeve comprising external threads at an end portion that engage the internal threads of the end portion of the first tubular member; wherein the tubular sleeve comprises an internal flange.

132. An apparatus, comprising:

a tubular sleeve;

a first tubular member coupled to an end of the tubular sleeve comprising internal threads at an end portion; and

a second tubular member coupled to another end of the tubular sleeve comprising external threads at an end portion that engage the internal threads of the end portion of the first tubular member; wherein the tubular sleeve comprises an external flange.

133. An apparatus, comprising:

a tubular sleeve;

a first tubular member coupled to an end of the tubular sleeve comprising internal threads at an end portion; and

a second tubular member coupled to another end of the tubular sleeve comprising external threads at an end portion that engage the internal threads of the end portion of the first tubular member; wherein the tubular sleeve further comprises one or more sealing members for sealing the interface between the tubular sleeve and at least one of the tubular members.

134. An apparatus, comprising:

a tubular sleeve;

a first tubular member coupled to an end of the tubular sleeve comprising internal threads at an end portion;

a second tubular member coupled to another end of the tubular sleeve comprising external threads at an end portion that engage the internal threads of the end portion of the first tubular member; and

a retaining ring positioned between the end of the first tubular member and the end of the tubular sleeve.

135. An apparatus, comprising:

a tubular sleeve;

a first tubular member coupled to an end of the tubular sleeve comprising internal threads at an end portion;

a second tubular member coupled to another end of the tubular sleeve comprising external threads at an end portion that engage the internal threads of the end portion of the first tubular member; and

a retaining ring positioned between the end of the first tubular member and the other end of the tubular sleeve.

136. An apparatus, comprising:

a tubular sleeve;

a first tubular member coupled to an end of the tubular sleeve comprising internal threads at an end portion; and

a second tubular member coupled to another end of the tubular sleeve comprising external threads at an end portion that engage the internal threads of the end portion of the first tubular member; wherein the end of the tubular sleeve is deformed onto the end of the first tubular member.

137. An apparatus, comprising:

a tubular sleeve;

a first tubular member coupled to an end of the tubular sleeve comprising internal threads at an end portion; and

a second tubular member coupled to another end of the tubular sleeve comprising external threads at an end portion that engage the internal threads of the end portion of the first tubular member; wherein the other end of the tubular sleeve is deformed onto the end of the second tubular member.

138. An apparatus, comprising:

a tubular sleeve;

a first tubular member coupled to an end of the tubular sleeve comprising internal threads at an end portion;

a second tubular member coupled to another end of the tubular sleeve comprising external threads at an end portion that engage the internal threads of the end portion of the first tubular member; and

a retaining ring coupled to the end of the first tubular member for retaining the tubular sleeve onto the end of the first tubular member.

139. An apparatus, comprising:

a tubular sleeve;

a first tubular member coupled to an end of the tubular sleeve comprising internal threads at an end portion;

a second tubular member coupled to another end of the tubular sleeve comprising external threads at an end portion that engage the internal threads of the end portion of the first tubular member; and

a retaining ring coupled to the end of the second tubular member for retaining the other end of the tubular sleeve onto the end of the second tubular member.

140. An apparatus, comprising:

a tubular sleeve;

a first tubular member coupled to an end of the tubular sleeve comprising internal threads at an end portion;

a second tubular member coupled to another end of the tubular sleeve comprising external threads at an end portion that engage the internal threads of the end portion of the first tubular member; and

a locking ring for coupling the end of the first tubular member to the end of the tubular sleeve.

141. An apparatus, comprising:

a tubular sleeve;

a first tubular member coupled to an end of the tubular sleeve comprising internal threads at an end portion;

a second tubular member coupled to another end of the tubular sleeve comprising external threads at an end portion that engage the internal threads of the end portion of the first tubular member; and

a locking ring for coupling the end of the second tubular member to the other end of the tubular sleeve.

142. An apparatus, comprising:

a tubular sleeve;

a first tubular member coupled to an end of the tubular sleeve comprising internal threads at an end portion;

a second tubular member coupled to another end of the tubular sleeve comprising external threads at an end portion that engage the internal threads of the end portion of the first tubular member; and

a structure for receiving the first and second tubular members and the tubular sleeve; wherein the tubular sleeve contacts the interior surface of the structure.

143. An apparatus, comprising:

a tubular sleeve;

a first tubular member coupled to an end of the tubular sleeve comprising internal threads at an end portion; and

a second tubular member coupled to another end of the tubular sleeve comprising external threads at an end portion that engage the internal threads of the end portion of the first tubular member; wherein the tubular sleeve further comprises a sealing element coupled to the exterior surface of the tubular sleeve.

144. An apparatus, comprising:

a tubular sleeve;

a first tubular member coupled to an end of the tubular sleeve comprising internal threads at an end portion; and

a second tubular member coupled to another end of the tubular sleeve comprising external threads at an end portion that engage the internal threads of the end portion of the first tubular member;

wherein the tubular sleeve is metallic.

145. An apparatus, comprising:

a tubular sleeve;

a first tubular member coupled to an end of the tubular sleeve comprising internal threads at an end portion; and

a second tubular member coupled to another end of the tubular sleeve comprising external threads at an end portion that engage the internal threads of the end portion of the first tubular member; wherein the tubular sleeve is non-metallic.

146. An apparatus, comprising:

a tubular sleeve;

a first tubular member coupled to an end of the tubular sleeve comprising internal threads at an end portion; and

a second tubular member coupled to another end of the tubular sleeve comprising external threads at an end portion that engage the internal threads of the end portion of the first tubular member; wherein the tubular sleeve is plastic.

147. An apparatus, comprising:

a tubular sleeve;

a first tubular member coupled to an end of the tubular sleeve comprising internal threads at an end portion; and

a second tubular member coupled to another end of the tubular sleeve comprising external threads at an end portion that engage the internal threads of the end portion of the first tubular member; wherein the tubular sleeve is ceramic.

148. An apparatus, comprising:

a tubular sleeve;

a first tubular member coupled to an end of the tubular sleeve comprising internal threads at an end portion; and

a second tubular member coupled to another end of the tubular sleeve comprising external threads at an end portion that engage the internal threads of the end portion of the first tubular member; wherein the tubular sleeve is frangible.

149. An apparatus, comprising:

a tubular sleeve;

a first tubular member coupled to an end of the tubular sleeve comprising internal threads at an end portion; and

a second tubular member coupled to another end of the tubular sleeve comprising external threads at an end portion that engage the internal threads of the end portion of the first tubular member; wherein the tubular sleeve comprises one or more longitudinal slots.

150. An apparatus, comprising:

a tubular sleeve;

a first tubular member coupled to an end of the tubular sleeve comprising internal threads at an end portion; and

a second tubular member coupled to another end of the tubular sleeve comprising external threads at an end portion that engage the internal threads of the end portion of the first tubular member; wherein the tubular sleeve comprises one or more radial passages.

151. An apparatus, comprising:

a tubular sleeve;

a first tubular member coupled to an end of the tubular sleeve comprising internal threads at an end portion; and

a second tubular member coupled to another end of the tubular sleeve comprising external threads at an end portion that engage the internal threads of the end portion of the first tubular member; wherein the first and second tubular members are amorphously bonded.

152. An apparatus, comprising:

a tubular sleeve;

a first tubular member coupled to an end of the tubular sleeve comprising internal threads at an end portion; and

a second tubular member coupled to another end of the tubular sleeve comprising external threads at an end portion that engage the internal threads of the end portion of the first tubular member; wherein the first and second tubular members are welded.

153. An apparatus, comprising:

a tubular sleeve;

a first tubular member coupled to an end of the tubular sleeve comprising internal threads at an end portion; and

a second tubular member coupled to another end of the tubular sleeve comprising external threads at an end portion that engage the internal threads of the end portion of the first tubular member; wherein the internal threads of the first tubular member and the internal threads of the second tubular member together provide a fluid tight seal.

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